

## Investigation of Toxic Raphidophyte Population Dynamics Using Molecular and Physiological Tools

Sara Handy  
Graduate Student  
University of Delaware Graduate College of Marine Studies  
(302) 645-4288  
shandy@udel.edu

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In 2000, an abrupt and unprecedented bloom of the toxic Raphidophyte *Chattonella verruculosa* reached densities as high as  $10^7$  cells/L in the Delaware Inland Bays (DIB), causing massive mortality of marine life. Extensive monitoring revealed the presence of Raphidophytes throughout the bays, and blooms have occurred several times since their discovery. Initially thought to consist of unialgal blooms of *Chattonella*, it has since become clear that Raphidophyte blooms in the bays are instead made up of a consortium of four Raphidophyte species. The abundance of each species in the blooms varies, suggesting that there are species-specific responses to the environment or that inter-specific interactions between Raphidophytes have variable outcomes, or both. The effects of environmental and physical factors, as well as biotic interactions, on the dominance and succession of mixed Raphidophyte blooms are currently unknown. This investigation addresses fundamental questions of Raphidophyte physiology and population dynamics. The goals of our project are to gain a better understanding of the effects of environmental perturbations and grazing pressure on Raphidophyte community dynamics; to identify environmental factors that stimulate the growth of Raphidophytes relative to other algal species; and to investigate the potential of Raphidophyte cyst distributions as an indicator of seasonal bloom “hot spots.”

In our investigation, Raphidophyte assemblages at several key sites in the DIB are routinely monitored in collaboration with Delaware’s Department of Natural Resources and Environmental Control (DNREC) and the Volunteer Phytoplankton Monitoring Group. The relative abundances of Raphidophytes versus other major algal taxa in the DIB are determined using sensitive molecular techniques, HPLC pigment analysis, and microscopic methods. Environmental parameters such as nutrients, light, temperature, and salinity are then correlated to Raphidophyte population dynamics. Sediment samples are also collected to determine the distribution and relative abundance of Raphidophyte cyst populations. Finally, the effect of bottom-up (nutrients and light) and top-down (grazing) controls on the four Raphidophyte species individually and in mixed assemblages are evaluated in laboratory investigations.

A detailed picture of how interacting environmental factors, such as nutrients and light, together affect the growth and biomass of Raphidophytes is essential in order to build a truly predictive understanding of bloom formation. Information on biological factors such as grazing and cyst distributions will add to our emerging picture of bloom dynamics. When this project is completed, we will be able to better evaluate how these factors affect the occurrence of mixed blooms in the DIB.